Port McNeill Forest District

Inventory Plan

MINISTRY OF FORESTS
RESOURCES INVENTORY BRANCH
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1. INTRODUCTION

1.1 Background

The Provincial Vegetation Resources Inventory (VRI) or Provincial Inventory is an improved vegetation (forest) inventory process or toolbox for assessing the quantity and quality of British Columbia's timber and other vegetation resources. It addresses the concerns expressed by the Forest Resources Commission in its 1991 report, *The Future of our Forests*. These concerns included:

- lack of statements of precision of the inventory;
- inadequate information on non-timber vegetation resources;
- lack of reliable estimates of growth rates and stand specific volumes; and
- narrow focus on commercial timber volume and the timber harvesting landbase.

The VRI can be implemented at a number of levels depending on the business needs. It can be deployed over the entire province (one or more Forest District at a time), measuring all the timber and non-timber resources. The VRI can also be deployed over a Management Unit (TFL or TSA) or a small watershed within a District, measuring selected resources in specific portions of the landbase.

The Provincial Inventory consists of a system of protocols, models and databases that can be managed through a dispersed computing environment. The Provincial Inventory process can be used to meet today's needs for timber supply, long term planning, silviculture planning, defining sustainability, public information and credibility. The Provincial Inventory can also provide data for computer modeling and decision support systems to support a baseline biodiversity assessment and for research.

The Vegetation Resources Inventory is designed to determine:

- the amount of vegetation cover in the province;
- the location of vegetation resources in the province; and
- the changes in the amount and location of vegetation resource over time.

The principles guiding the implementation of the inventory are:

- to integrate provincial inventory activities (e.g. Management Inventories, Provincial Inventory, National Forest Inventory and Monitoring);
- to implement inventory projects to satisfy business requirements as defined in the inventory plans; and
- to maximize the usefulness of sample plots and minimize overall costs by implementing a cascading plot approach that ensures that information collection meets the VRI standards while meeting multiple goals.

Management Inventories include inventories conducted in Implementation Units[1], to fulfill specific forest management or business needs. Sampling error and sampling intensity are controlled for specific vegetation attributes (e.g., timber volume) to achieve specific inventory objectives. There are several types of Implementation Units in the province: Timber Supply Areas (TSAs), Tree Farm Licenses (TFLs), and other lands (parks, private lands, and other public lands). Within (or across) these Implementation Units there may be Management Inventories addressing specific issues such as Problem Forest Types, or other strata in a TSA (or groups of TSAs).

Management Inventories are typically timber emphasis inventories. Besides providing detailed polygon information for day-to-day forest management, they can also be used to increase precision of the Provincial Inventory. The TFL holders or the MoF Regions/Districts are responsible for the planning and implementation of these inventories. However, the Ministry of Forests Resources Inventory Branch requires the TFL holder(s), stakeholder(s), or District(s) to prepare an inventory business plan, which includes a sampling plan, for its approval. An inventory business plan defines the inventory needs, the information needed to meet the needs, and the methods for collecting the information. This business plan then drives the inventory project plans.

1.2 Objectives

This is a plan for implementing the Provincial Vegetation Resources Inventory and Management Inventory activities in the Port McNeill Forest District in the Vancouver Forest Region. This plan was developed through consultation with various stakeholders during October 1997 in the Port McNeill Forest District, including the Ministry of Forests, Branch, Region and District staff, and the Licensees' staff from Western Forest Products, Canadian Forest Products, MacMillan Bloedel, Scott Paper, International Forest Products and TimberWest Forest Products, who identified inventory local needs and priorities. Management issues identified in the recent TSR in the TSA were also reviewed.

The purpose of the Inventory Plan is to:

1. define the Management Inventory objectives;
2. define the Provincial Inventory strategy for Port McNeill Forest District;
3. identify the inventory activities required to satisfy the objectives for both inventories; and
4. outline the implementation steps.

This plan is based on the consultant report, *Port McNeill Forest District Vegetation Resources Inventory Ground Sampling Plan*, prepared by J.S. Thrower & Associates. The report was prepared following the procedures outlined in the Ministry of Forests, Resources Inventory Branch procedures, *Vegetation Resources Inventory: Preparing a*

[1] Implementation Units are a specified area of land such as a TSA, TFL, Innovative Forest Practices Agreement area, etc. For any Implementation Unit, there can be none to several Management Inventories based on stakeholder business needs.

sampling plan for ground sampling (March 1997). The report has been reviewed by stakeholders in the District and is attached to this Inventory Plan (see Appendix A).

2. BUSINESS CONSIDERATIONS

2.1 Forest Management Issues

Forest management issues were identified during the recent timber supply review (Table 1). An assessment of potential impacts of the VRI ground sampling on these management issues is also shown in this table.

Table 1. Forest management issues for the Port McNeill Forest District and potential impacts for VRI.

Issue[2]	Remarks
1. Site productivity: assess results of paired plot study.	Measurements from Phase II plots can be used to check existing site index estimates. However, these data will not address the issue of potential site index and productivity of stands. As well, they will not correct deficient site curves.
2. Inventory audit results has indicated uncertainty in the inventory information.	Check and improve District net volumes by removing overall possible bias and net volume adjustment. Statistical statements of accuracy for the overall inventory will be provided.
3. Visual landscape inventory information.	Application of the Inventory
4. Environmentally sensitive area soils: clarify estimated area of sensitive soils.	Application of the Inventory
5. Commercial thinning possibilities must be analyzed for their potential.	Application of the Inventory
6. Wildlife habitat: incorporate into future analyses.	Plant lists, forage production, lichen production, and shrub transects from Phase II plots provide TSA totals, which could be used to confirm base interpretations for wildlife. Improved Phase I estimates will provide additional information on delineating wildlife habitat and protected areas.
7. Deciduous – alder: investigate discrepancies between licensee and BCFS volume estimates.	Application of the Inventory
8. Archaeological/traditional use: incorporate into future analyses.	Plant lists from Phase II plots will provide incidence data for medicinal plans and other botanical forest products, which can be used as a basis for additional sampling.

[2] BC Ministry of Forests, Timber Supply Branch. 1996. Forest Management Issues Identified Through the AAC Determination Process. TSA/TFL Timber Supply Reviews: 1992-1996. 31 December 1996. Victoria BC. Pages 191-195.

	Issue[2]	Remarks
9.	Vancouver Island LUP: review possible changes to management objectives.	Application of the Inventory
1	Biodiversity: assess impacts.	Phase II will provide overall District totals for coarse woody debris, stumps, potential wildlife trees, and plant lists for species diversity. The precision of these totals should be evaluated, by Natural Disturbance Types (NDTs), before being compared to the biodiversity guidelines. There is a risk that precise estimates will not be obtained for these attributes. The data can be used to identify supplemental sampling needs.
1	Inventory update: monitor effect of current SBFEP undercut.	Application of the Inventory
1	Roads, trails and landings: review and refine deduction factors.	Application of the Inventory
1	LRMP: incorporate into future analyses.	Application of the Inventory
1	Temporary deferrals: consider Part 15 Forest Act AAC reduction.	Application of the Inventory

TFL 6

1.	Biodiversity: prepare biodiversity plan for next AAC.	Phase II will provide overall District totals for coarse woody debris, stumps, potential wildlife trees, and plant lists for species diversity. The precision of these totals should be evaluated, by Natural Disturbance Types (NDTs), before being compared to the biodiversity guidelines. There is a risk that precise estimates will not be obtained for these attributes. The data can be used to identify supplemental sampling needs.
2.	Regenerated stand volumes: prepare new yield curves that more accurately reflect the conditions of the stands being modeled.	Application of the Inventory
3.	Site productivity: review ecosite classification system used to estimate site productivity.	This issue has been addressed by the TFL holder.
4.	Deciduous, mixed deciduous: report performance in these stands.	Application of the Inventory
5.	ESAs, wildlife habitat, archaeological sites, biodiversity, and total resource plans: complete resource and ESA inventories required.	This issue has been addressed by the TFL holder.

	Issue[2]	Remarks
6.	Stream classification: licensee must complete by 1996 a classification of all streams in the TFL to FPC standards.	Application of the Inventory
7.	Inventory Audit: scheduled for completion in 1998.	Phase II data can confirm the Inventory Audit results, when questions about the audit methodology are resolved.
8.	Unsalvaged losses: quantify.	Application of the Inventory
9.	Operability: assess prior to MP #9.	Application of the Inventory
1	Commercial thinning: licensee should explore commercial thinning opportunities.	Application of the Inventory
1	Fertilization: if undertaken, implications will be considered in next AAC review.	Application of the Inventory
1	Protected areas: quantify impacts of implementing plan.	Application of the Inventory

TFL 25 – Block 4

1	Riparian areas: rationalize approach to riparian classifications.	Application of the Inventory
1	Regenerated stand volumes: develop a more appropriate yield estimation procedure for balsam.	Application of the Inventory
1	OAFs: develop more appropriate OAF 1 for Douglas-fir.	Application of the Inventory
1	Site productivity: develop more sophisticated and reliable methodologies to determine site indexes.	Application of the Inventory
1	Hemlock, height class 3: report performance in height class 3 hemlock stands in all blocks.	Application of the Inventory
1	ESAs: update and refine soil stability inventories.	Application of the Inventory
1	Audit and reinventory results: incorporate into future TSRs.	Inventory Audit is scheduled for 1999; A VRI timber emphasis inventory may be completed instead.

	Issue[2]	Remarks
2	Inventory plot database: update to reflect management changes.	Phase II plots will add to the inventory database.
2	ESAs regeneration: complete ecosystem mapping to resolve discrepancy between Block 5 and other blocks.	Application of the Inventory
2	Wildlife habitats: complete mapping projects now underway.	Ecological mapping has been completed for TFL 25.
2	Operability: further data on inoperable and inaccessible terrain should be available for next determination.	Application of the Inventory
2	Unsalvaged losses: better data and greater methodological rigour required.	Application of the Inventory
2	20-year plan: revisit determination if district approvals require subsequent revision.	Application of the Inventory

TFL 39

2	Biodiversity: develop and incorporate biodiversity objectives into next analysis.	Phase II will provide overall District totals for coarse woody debris, stumps, potential wildlife trees, and plant lists for species diversity. The precision of these totals should be evaluated, by Natural Disturbance Types (NDTs), before being compared to the biodiversity guidelines. There is a risk that precise estimates will not be obtained for these attributes. The data can be used to identify supplemental sampling needs.
2	Alternative silviculture systems: quantify growth and yield impacts.	Application of the Inventory
2	Stand tending: quantify impact on minimum harvestable ages.	Application of the Inventory
2	Decay, waste, and breakage: prior to next analysis, provide further support for factors used in recent analysis.	Decay is not an issue for the TFL, only waste and breakage. Phase II NVAF process will check decay and waste estimates, but not breakage.
3	Green-up: undertake further specific analysis regarding projected greenup periods.	Application of the Inventory

	Issue[2]	Remarks
3	Minimum harvestable ages: evaluate product stand management objectives vs. minimum harvestable ages.	Application of the Inventory
3	Merchantability assumptions: ensure balanced harvest profile.	Application of the Inventory
3	Visual sensitive areas: review landscape inventories.	Application of the Inventory
3	Unsalvaged losses: monitor actual losses and review estimation procedures.	Application of the Inventory
3	Vancouver LUP: incorporate into next analysis.	Application of the Inventory
3	Biodiversity: incorporate landscape biodiversity objectives into next analysis.	Phase II will provide overall District totals for coarse woody debris, stumps, potential wildlife trees, and plant lists for species diversity. The precision of these totals should be evaluated, by Natural Disturbance Types (NDTs), before being compared to the biodiversity guidelines. There is a risk that precise estimates will not be obtained for these attributes. The data can be used to identify supplemental sampling needs.
3	Watershed assessment: incorporate assessments into future analysis.	Application of the Inventory
3	Temporary deferrals: consider Part 15 Forest Act AAC reduction.	Application of the Inventory

TFL 43

3	Biodiversity: incorporate forest-, landscape-, stand-, and genetic-level biodiversity measures in next analysis.	Phase II will provide overall District totals for coarse woody debris, stumps, potential wildlife trees, and plant lists for species diversity. The precision of these totals should be evaluated, by Natural Disturbance Types (NDTs), before being compared to the biodiversity guidelines. There is a risk that precise estimates will not be obtained for these attributes. The data can be used to identify supplemental sampling needs.
4	ESAs: review, update and map all ESAs for next analysis.	Application of the Inventory

	Issue[2]	Remarks
4	Riparian areas: further assess implications of Code riparian zones for next analysis.	Application of the Inventory
4	Existing volumes: develop stand yield data for existing cottonwood stands.	Phase II data can be used to check yield estimates.
4	Site productivity: refine site index estimates for managed cottonwood stands.	Application of the Inventory
4	Decay, waste, and breakage: quantify factors for cottonwood stands.	Phase II NVAF process can be used to check decay and waste estimates, but not breakage.
4	Plots: submit schedule for establishment of G&Y plots for cottonwood.	Application of the Inventory
4	Fertilization: quantify effects on cottonwood stands.	Application of the Inventory
4	Minimum harvestable ages: refine data regarding minimum harvestable ages for cottonwood stands.	Application of the Inventory
4	Archealogical sites: refer harvesting plans to First Nations.	Application of the Inventory
4	Inventory audit: complete audit required.	Inventory Audit is scheduled for completion in 1999.
5	Forest cover update: provide updated information for review prior to next analysis.	The VRI will update information on forest cover.
5	Landscape inventory: complete landscape inventory in Homathko and Kingcome blocks and identify VQOs for next analysis	Application of the Inventory
5	Erosion and accretion: quantify landbase losses to these factors.	Application of the Inventory
5	Operability: review any inclusions of currently inoperable land.	Application of the Inventory

	Issue[2]	Remarks
5	Schedule B prorate: submit proposed and current prorate for Schedule B lands.	Application of the Inventory
5	Stand conversion: provide estimated time frame for conversion to cottonwood stands in Kingcome and Homathko blocks.	Application of the Inventory
5	Regeneration delay: monitor regeneration performance.	Application of the Inventory
5	Alternative silvicultural systems: document any plans to use selection harvesting in next management plan.	Application of the Inventory
5	Regenerated stand volumes: advise when volume-based timber supply analyses will be feasible.	Application of the Inventory

TFL 45

5	Operability: operating in marginal and helicopter logging stands must continue to support AAC.	Application of the Inventory
6	Biodiversity: develop landscape-level biodiversity plan for next determination.	Phase II will provide overall District totals for coarse woody debris, stumps, potential wildlife trees, and plant lists for species diversity. The precision of these totals should be evaluated, by Natural Disturbance Types (NDTs), before being compared to the biodiversity guidelines. There is a risk that precise estimates will not be obtained for these attributes. The data can be used to identify supplemental sampling needs.
6	Site productivity: refine site index estimates.	Application of the Inventory
6	Wildlife habitat -mountain goat: identify landbase affected and clarify impact for next determination.	Plant lists, forage production, lichen production, and shrub transects from Phase II plots provide TSA totals, which could be used to confirm base interpretations for wildlife. Improved Phase I estimates will provide additional information on delineating wildlife habitat and protected areas.
6	Inventory audit: complete audit required.	Inventory Audit is scheduled for 1998.
6	Wildlife habitat: correct mapping error prior to next determination.	Application of the Inventory

	Issue[2]	Remarks
6	Roads, trails and landings: refine loss estimates for next determination.	Application of the Inventory
6	Unsalvaged losses: use better data and greater methodological rigour to identify estimates in future.	Application of the Inventory
6	20 year plan: monitor operational feasibility of increasing harvest in Knight Inlet.	Application of the Inventory
6	Resource management zones, higher level plans: licensee intends to seek designation of MP 3 as higher level plan; if successful, will be accounted for in future determinations.	Application of the Inventory
6	Regeneration: better identify impediments to prompt regeneration and address in future analyses.	Application of the Inventory
7	Species conversion: strategy required if licensee commits to converting deciduous to coniferous stands.	Application of the Inventory
7	Incremental silviculture: encourage licensee to pursue activities that could improve timber supply.	Application of the Inventory

TFL 47

7	Biodiversity: prepare/implement landscape-level plan.	Phase II will provide overall District totals for coarse woody debris, stumps, potential wildlife trees, and plant lists for species diversity. The precision of these totals should be evaluated, by Natural Disturbance Types (NDTs), before being compared to the biodiversity guidelines. There is a risk that precise estimates will not be obtained for these attributes. The data can be used to identify supplemental sampling needs.
7	Watershed assessments: monitor operations to evaluate if planned activities achieve Code watershed requirements.	Application of the Inventory
7	Alternative silvicultural system: determine/quantify G&Y implications.	Application of the Inventory
7	Minimum harvestable ages: monitor performance in young stands.	Application of the Inventory

	Issue[2]	Remarks
7	Visually sensitive areas: logging to occur in these areas if to continue to contribute to the harvesting landbase.	Application of the Inventory
7	Inventory audits: monitor results.	Inventory Audit for the Bonanza Lake Block is scheduled for 1998; Johnson Strait Block is complete.
7	Recreation: maintain and update recreation inventories.	Application of the Inventory
7	Roads, trails, and landings: provincial review to provide consistent approach.	Application of the Inventory
8	Unsalvaged losses: monitor actual losses and examine methodology used to estimate losses.	Application of the Inventory
8	Operability: monitor harvest operations to evaluate operability criteria.	Application of the Inventory
8	Regeneration delay: monitor regeneration performance.	Application of the Inventory
8	Regeneration: quantify timber supply impacts of use of genetically improved stock in combination with silvicultural treatments such as fertilization.	Application of the Inventory
8	Archaeological and heritage resources: continue consultations with Haida Nation and develop strategy for protection of culturally modified trees in next management plan.	Plant lists from Phase II plots will provide incidence data for medicinal plans and other botanical forest products, which can be used as a basis for additional sampling.
8	Temporary deferrals: consider Part 15 Forest Act AAC reduction.	Application of the Inventory

2.2 Inventory Issues

The following is a list of inventory issues developed from the forest management issues and the Stakeholders meeting:

- Timber inventories are inaccurate in the TSA and not audited in most TFLs.
- Cedar/Cypress low site stratification.
- Biodiversity.

- Decay, waste, and breakage, especially in cedar.
- Site index and SIBEC information.
- Polygon delineation and estimation of forested areas and non-productive areas.
- TEM/Forest Cover retrofit.
- Species lists and other ecological information, especially in Parks.
- Inventory of second-growth stands in the District.
- Monitoring tree taper, decay estimates, and inventory projections.
- Provincial and district monitoring of the indicators of sustainable forest management, as defined by the Canadian Council of Forest Ministers (CCFM).[3] Monitoring would involve measuring changes and trends in some of these indicators, which include percent and extent of area by forest type and age class, and mean annual increment by forest type and age class.
- Issues raised by the Forest Resources Commission's 1991 report, *The Future of Our Forests*, regarding the inadequacy of forest inventories in the province. These concerns included lack of statements of precision on the inventory, inadequate information on non-timber vegetation, and the narrow focus on commercial timber volume and the operable landbase.

Other issues identified that are specific to the VRI itself were:

- Database issues such as replacement of cultural definitions (e.g., NSR) with actual data.
- Lack of completed VRI results and products (e.g., maps).

3. INVENTORY PLAN

3.1 Provincial Inventory

3.1.1 Provincial Inventory Landbase

The inventory unit for the Port McNeill VRI is the Port McNeill Forest District. The Port McNeill Forest District total area is 2,548,149 ha and includes the TSA, TFLs (within the District boundaries), and Parks (within the District boundaries).

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[3] Canadian Council of Forest Ministers. 1995. Defining sustainable forest management. A Canadian approach to criteria and indicators. Natural Resources Canada. Canadian Forest Service. Ottawa, Ontario. 22 pages.

3.1.2 Objectives

3.1.2.1 Photo Interpretation

The need for a new Phase I inventory has been identified. Efforts are currently underway to improve the TSA inventory at the individual polygon level. The new Phase I data should be used to evaluate the potential benefits of new photo interpretation compared to the current data.

3.1.2.2 Ground Sampling

The objective of the Port McNeill Forest District VRI ground sampling is to provide overall totals and averages for timber and non-timber vegetation resources (medicinal plants and other botanical forest products) in the District. The sampling will target a ± 10% sampling error (95% probability) for net timber volume in the treed portion of the District, and allow for the calculation of sampling errors for other VRI attributes. The key attributes of interest in the Port McNeill VRI are stand age, net volume by species, and stand height. Information will be collected on all attributes, but the variability of identified key attributes will be used to set the sample size for the VRI.

3.1.3 Sampling Plan

3.1.3.1 Sample Size

To achieve the inventory objectives as identified above, the sample sizes required to implement the Provincial Inventory are summarized in Table 2. In inventory, a sampling error standard is necessary to provide a basis for determining sample size. In the VRI, the allowable sampling error standard is set at ±10% for volume estimation at the Unit/District level. This standard does not apply to other attributes in the inventory.

The number of samples required to achieve the standard is a function of the variation within the inventory unit, estimated by the coefficient of variation (CV%). The estimated CV in the Port McNeill Forest District used to estimate the total number of plots to achieve a sampling error of ±10% for net volume is 45%[4]. To achieve the VRI standard at a reasonable cost, two types of VRI plots will be used:

- full VRI samples, where the full suite of information (timber, coarse woody debris, range and ecology) is collected; and
- tree emphasis samples, where only tree information is collected.

The total number of full VRI samples (40) will be adequate to achieve a sampling error of ±15% in the treed landbase. Tree emphasis samples (TEP) (40) will then be used to reduce the sampling error in the treed landbase to ±10% to achieve the standard.

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[4] The inventory audit CV was inflated by 25% to account for the possible differences between the CV estimates based on the VRI design (a tight 5-plot cluster) and based on the inventory audit (a well-distributed 9-plot cluster).

In the remaining non treed area of the unit, the number of full VRI samples established will be the ratio of the treed to remaining landbase, multiplied by the number of treed VRI samples required to achieve a sampling error of ±15% (40).

Implementing the two types of samples will ensure a minimum number of full VRI plots are established across the landscape to collect the full suite of VRI information. Establishing TEPs to boost the number of plots required to achieve the VRI standard will result in saved time and money.

To complete the Provincial Inventory, NVAF (net volume adjustment factor) and WPV (within polygon variation) sampling is required. The numbers of these types of samples are contained in Table 2.

Table 2. The estimated sample size required to implement the Provincial Inventory.

Ground Sampling Activity	Sampling Unit	VRI Samples	Tree Emphasis Samples	Sample Size
Provincial Inventory				
Vegetated Treed	Cluster	40	40	80
Other	Cluster	40	-	40
Net Volume Adjustment Factor	Tree	75		75
Within Polygon Variation	Polygon	30		30

3.1.3.2 Provincial Inventory Sampling

To achieve the Provincial Inventory objective, the sampling should be implemented in a two-step process. Step 1 is to install a approximately 100 sample clusters in the first field season over the entire District. Step 2 is to install the remaining sample clusters in the second field season. The sampling locations will be selected systematically from the sorted list of potential sampling points. This list will include all polygons in the District and will be sorted by non-vegetated/vegetated and then land type, leading tree species, age, and site index. Sampling in the first year will provide experience to refine the process for the second field season, and information to calculate precisely the remaining number of samples required to meet the precision target of ±10% for total net volume in the treed portion of the District. An estimated total of 120 sample clusters will be assumed for planning, training, and other logistic considerations. Matching unavailable sampling sites with sub-sampling of sample clusters with difficult access will be anticipated and planned for, as these activities will increase inventory costs.

A two-step approach should also be used for implementing the other ground sampling activities that support the Provincial Inventory process: NVAF sampling and WPV sampling. NVAF provides a factor to adjust the net volume from the ground sampling (derived from the net factoring process and taper equations) to account for hidden decay and possible bias in taper equations. WPV information is used to express the total error of the inventory and to indicate accuracy of individual polygon estimates. A total of 75 sample trees for NVAF sampling (selected from 15 treed and 1 non-treed polygons) and 30 sample polygons for WPV sampling are required.

3.2 Management Inventory

3.2.1 Management Unit Landbase

Management Units are separate populations created within the inventory unit (District) to control sampling error and sampling intensity for specific attributes. Six Management Units were identified in the Port McNeill Forest District to address the inventory issues raised by the stakeholders. These Management Units are designed to improve the timber inventory (volume, height, and age) in the timber harvesting landbase, where needed in each of the Kingcome TSA, TFL 6, TFL 25, TFL 37, TFL 43, and TFL 45. Table 3 provides an approximation of the area to be assessed by the Provincial and Management Inventories.

Table 3. Area by Inventory Unit within the Port McNeill Forest District

Inventory Type	Inventory Unit	Area (ha)
Provincial Inventory	Forest District	2,548,149
Management Unit		
Kingcome TSA	Second Growth Stands	1,870,000*
TFL 6	Second Growth Stands	170,213*
TFL 25 (Block 4)	Second Growth Stands	31,300*
TFL 37	Treed Landbase	190,000*
TFL 39	Not Defined	68,000*
TFL 43	Treed Landbase	962*
TFL 45	Treed Landbase	180,000*
TFL 47	Not Defined	37,674*

* Areas indicate the total Management Unit area.

3.2.2 Objectives

3.2.2.1 Photo Interpretation

New photo interpretation for the Management Units within the Forest District was identified. The objective for the Photo Interpretation is to improve individual polygon descriptions for the TSA, and TFLs 6, 25, 37, 43, and 45. This inventory should be implemented after the data from the VRI ground sampling photo-typing are analyzed, to confirm if there is need for this project.

3.2.2.2 Ground Sampling

The ground sampling objectives for the Management Inventories are to:

- *Kingcome TSA*: The objective of this Management Inventory is to improve the accuracy of timber net volume and site index (focusing on second growth) in the Kingcome TSA within the Port McNeill Forest District.
- *TFL 6 and TFL 25 (Block 4)*: The objective of these Management Inventories are to improve the accuracy of timber net volume and site index (second-growth

stands) in TFL 6 and TFL 25 (Block 4) within the Port McNeill Forest District, if needed.

- *TFL 37*: The objective of this Management Inventory is to improve the accuracy of timber net volume of Canadian Forest Products' TFL 37 in the Port McNeill Forest District.
- *TFL 39*: No ground sampling activity as MacMillan Bloedel considers their inventory to be adequate for their forest management needs.
- *TFL 43*: The objective of this Management Inventory is to improve the accuracy of timber net volume and site index in the treed portion of TFL 43.
- *TFL 45*: The objective of this Management Inventory is to improve the accuracy of timber net volume and site index in the entire treed portion of TFL 45 (International Forest Products) in the Port McNeill Forest District.
- *TFL 47*: No ground sampling activity as TimberWest considers their inventory to be adequate for their forest management needs.

3.2.3 Sampling Plans

To achieve the objectives of the Management Inventories, Timber Emphasis Sampling will be required. The Timber Emphasis Sampling must meet the minimum sampling requirements as specified in *Implementation Strategy to Integrate Management, Provincial and National Inventories* (MoF, Resources Inventory Branch) The supplemental sampling will involve the installation of approximately:

- 158 sample clusters in the second growth stands of the Kincome TSA;
- 98 sample clusters in the second growth stands of TFL 6;
- 101 sample clusters in the second growth stands of TFL 25 (Block 4);
- 99 sample clusters in the "treed" landbase of the TFL 37;
- 50 sample clusters in the "treed" landbase of the TFL 43;
- 93 sample clusters in the "treed" landbase of the TFL 45;

The implementation should proceed immediately in a manner similar to the Provincial Inventory Phase II sampling. The sampling will be spread over a period of 2 years, with unbiased interim results expected after the first season. Sampling in the first year will provide experience to refine the process for the second field season, and information to calculate precisely the remaining number of samples required to meet the precision target of ±10% for timber volume in the timber harvesting landbase.

NVAF sampling is not required for Management Inventories however it is strongly encouraged. Stakeholders should identify within their more detailed *Inventory Plans*[5] if NVAF sampling is to be conducted.

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[5] Inventory Plans are required by stakeholders in order to proceed with their Management Inventories.

4. IMPLEMENTATION STRATEGY

The ground samples that are established to meet the Management Unit objectives are compatible with the Provincial Inventory objectives providing that these dual purpose plots are identified prior to establishment. Therefore, Provincial Inventory plots will be identified prior to identifying the Management Unit ground sampling plots. These coincident plots will be used for both the Provincial and Management inventories. Additional Management Inventory samples will be established to meet Management Inventory objectives. This integrated approach, that uses one set of samples to address multiple inventory needs, will result in minimum implementation costs.

There may be a need to enhance the coincident plots for non-timber attributes within the Management Units depending on the implementation strategy chosen. Additional Provincial Inventory ground samples will need to be established in the non-Management Inventory area in order to complete the Provincial Inventory for the Kamloops and Clearwater Forest Districts.

The inventory outlined above will be completed to the Ministry of Forests minimum standards as outlined in *Implementation Strategy to Integrate Management, Provincial and National Inventories*.

4.1 Steps

There are several ways to complete the ground sampling in the two-step process stated above. It is hoped that stakeholders will complete all the required ground sampling in a timely manner. One possible scenario is as follows:

1. Install a large number of each Management Inventory sample clusters (e.g., 100) over the entire landbase measuring *only those* tree attributes related to timber volume and site index. Install the Provincial Inventory samples for plots that are designated "multi-purpose" and install tree emphasis plots for the others. This will provide the experience to refine the process for the second field season and will provide information to calculate the required number of remaining sample clusters.
2. Install the remaining Management Inventory sample clusters in the second field season. (Note: the stakeholder may choose to install all ground samples in one field season).

4.1.2 Implementation Process

The implementation process will proceed based on available funding and can be implemented based on a number of scenarios. All implementation scenarios will a common process. One possible implementation process could proceed as follows:

1. Assemble all polygons within the District into one list; check to ensure no areas are missing or double counted.
2. Sort the polygon list according to the criteria: BC Land Cover Classification code, estimated leading tree species, age, and site index.

3. Select potential sampling points from the sorted list, as described in the Ministry of Forests, Resources Inventory Branch document *Vegetation Resources Inventory: Preparing a sampling plan for ground sampling.*
4. Stratify list to *vegetated treed* and *remaining area* (non-vegetated, vegetated non-treed).
5. Systematically select the Provincial Inventory samples by stratum.
6. Systematically select the polygons for the WPV sampling from the list of Provincial Inventory samples.
7. Systematically select the 16 NVAF sample points (15 treed and 1 non-treed whether or not volume is indicated) from the Provincial Inventory ground samples.
8. Stratify the District to determine the Provincial Inventory samples that meet Management Inventory objectives. Subtract this number of samples from the total required for each Management Inventory. Select the remaining number of Management Inventory samples.
9. For each Management Inventory, systematically select a batch of sampling points from the list of operable sampling points (80% of the sample size) and from the list of inoperable sampling points (20%).
10. Begin planning for field sampling.
11. Prepare a field sampling plan that includes sample cluster batches to ensure an unbiased sample is attained at the end of the first field season. Identify NVAF sample points and ensure they are field sampled early in the field season.
12. Locate and measure ground sample clusters.
13. Monitor quality assurance of field data and procedures during field sampling. Arrange for 'audit quality cruisers' to sample auxiliary plots of NVAF samples.
14. Compile the data in the fall and winter of the first year. This will include computing averages of timber volume, basal area, and regression of photo estimated volume to ground sample volume and the associated standard error of the regression.
15. Prepare NVAF tree sampling matrix. Begin NVAF destructive sampling.
16. Prepare for the second step during the winter. This will include calculation of the CV based on the standard error of the regression. The remaining number of samples required to achieve the stated desired precision can then be accurately determined using standard procedures (see Appendix B).
17. Prepare the remaining samples.
18. Locate and measure remaining ground sample clusters in the second field season. Complete stem analysis of the NVAF sample trees. Complete the within polygon variation sampling.

19. Compile all data, do the statistical adjustments and load final inventory results into the provincial database.

4.2 Cost

4.2.1 Provincial Inventory

The Provincial Inventory costs, for planning purposes, are summarized in Table 4.

Table 4. Estimated costs required to complete the Provincial Inventory sample plan.

Ground Sampling Unit	Sample size	Unit Cost* ($)	Total Cost ($)
Provincial Inventory			
Sample Cluster (VRI)	80	2,500	200,000
Sample Cluster (tree only)	40	1,500	60,000
Net Volume Adjustment Factor – (tree)	75	500	37,500
Within Polygon Variation	30	1,500	45,000
Total			342,500

* The unit costs are based on experience gained from the Boston Bar Operational Trial.

A CV of 45% and the objective precision level of ±10% sampling error (at the 95% probability level) were used to estimate the required number of Provincial Inventory samples.

Sampling efficiency and cost effectiveness will be achieved by implementing the Provincial Inventory ground sampling in combination with the Management Unit sampling. Results of the VRI ground sampling can be evaluated to determine the additional sampling required to meet the specific objectives.

4.2.2 Management Inventory

The costs for completing the Management Inventory plan, including the incremental cost of establishing the Provincial Inventory ground samples, are identified in Table 5.

Table 5. Estimated costs required to complete the Management Inventory sample plan.

Ground Sampling Unit	Sample size	Unit Cost ($)	Total Cost ($)
Management Unit			
Kingcome TSA	158	1,500	237,000
TFL 6	98	1,500	147,000
TFL 25 (Block 4)	101	1,500	151,500
TFL 37	99	1,500	148,500
TFL 43	50	1,500	75,000
TFL 45	93	1,500	139,500
Total			898,500

* N/A until the Inventory Audit is completed.

The sample size determination for the Management Unit sampling can be found in the consultant report, *Port McNeill Forest District Vegetation Resources Inventory Ground Sampling Plan, Revised Final Report* (Appendix A). The required number of Management Inventory samples is based on the appropriate CV (estimated) and the objective precision level of ±10% sampling error (at the 95% probability level).

4.2.3 Combined Management and Provincial Inventories

Implemented separately, the total cost of the Provincial and Management Inventories would be approximately $1,241,000. Combining the inventory objectives through a common implementation strategy will realize a saving. Given the multiple Management Units within the Williams Lake TSA and their overlapping areas, it is difficult to estimate the magnitude of these savings. However, the savings on the Provincial Inventory samples would be approximately $171,000 based on implementing all of the vegetated treed VRI and tree emphasis samples in combination with the Management Unit plots.

Table 6 illustrates the cost for one possible implementation scenario where overlap occurs between one of the Management Units and the Provincial Inventory. The total cost could be higher or lower if the assumptions stated above are not valid. For example, an increase in the CV or a reduction in the desired precision level will result in an increase in the number of samples required to achieve the objectives. The relationship between the sampling error and sample size is illustrated in the contractor report (Appendix A).

Table 6. Combined costs to complete the Management and Provincial Inventory sample plans.

Ground Sampling Unit	Sample size	Unit Cost ($)	Total Cost ($)
Management Unit			
Kingcome TSA	158	1,500	237,000
TFL 6	98	1,500	147,000
TFL 25 (Block 4)	101	1,500	151,500
TFL 37	99	1,500	148,500
TFL 43	50	1,500	75,000
TFL 45	93	1,500	139,500
Incremental Provincial Inventory Ground Samples			
Sample Cluster (upgrade to full VRI)	77*	1,000	77,000
Sample Cluster (tree only)	37*	0	0
Provincial Inventory (Remaining)			
Sample Cluster (VRI)	3	2,500	7,500
Sample Cluster (tree only)	3	1,500	4,500
Net Volume Adjustment Factor - Tree	75	500	37,500
Within Polygon Variation	30	1,500	45,000
Total			1,070,000

*Tree information component to be captured as part of the Management Unit sample

The total cost could be higher or lower if the assumptions stated above are not valid. For example, an increase in the CV or a reduction in the desired precision level will result in an increase in the number of samples required to achieve the objectives. The relationship between the sampling error and sample size is illustrated in the contractor report (Appendix A).

Depending on the implementation strategy, the savings will vary. The savings realized reflect the comparative overlaps of the Management Inventories. The numbers in Table 6 reflect one possible implementation scenario. Costs will change depending on the actual implementation scenario chosen.

4.3 Monitoring

The Ministry of Forests, Resources Inventory Branch is responsible for monitoring this Inventory Plan.

5. APPROVAL/SIGNING

I have read and concur with the Port McNeill Forest District Inventory Plan, June 19, 1998. It is understood that this is an agreement-in-principle and does not commit the signatories to completing the inventory activities outlined within the plan. Modifications to this plan or more detailed plans need to be reviewed and approved by the signatories and then appended to this plan.

District Manager Port McNeill Forest District	MacMillan Bloedel
Regional Manager Vancouver Forest Region	Scott Paper
Director Resources Inventory Branch	International Forest Products
Western Forest Products	TimberWest Forest Products
Canadian Forest Products	

Appendix A

Port McNeill Forest District
Vegetation Resources Inventory
Ground Sampling Plan

Appendix B

Polygon Selection